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ABSTRACT

Digital technology has turned a new page for television broadcasting. The convergence of television and computer has brought about powerful effects to television viewing experiences. Digital broadcasting combined with the Internet is conceived as a new driving force that will change the mode of learning in the very near future. Many educators perceive that Digital Television (DTV) and technology would possibly improve the current state of interactivity in the distance education environment due to its advanced features. High resolutions and digital transmission would make the communication much more clear and easier. One possible use of DTV in education, as Carvin (1998) described, would be enhanced TV, which is supplemented by multimedia content to provide interactivity for learning needs. Various contents such as Web pages, quick time movies and text scripts can be composed into the framework of course design. However, DTV technology is still in an early developing stage. There is insufficient information and few studies on its pedagogical uses have been done for educators. This review explores DTV's attributes, and discusses some possible applications for interactivity and the underlying theoretical and research bases. (Contains 19 references.) (AEF)

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Digital Television: The Future of Education?

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Introduction

Digital technology has turned a new page for TV Broadcasting. The convergence of television and computer brought about powerful effect to TV viewing experiences. Not only in the TV evolution, but also in the distance education, digital broadcasting combined with the Internet is conceived as a new driving force that will revolutionarily change the mode of learning in the very near future.

ITV program and Web-based instruction have appeared to be the most common ways of distance course delivering in the past one decade. Each of them has different attributes that meet different learners' need. However, many educators believe that the interaction and two-way communications that are required for all learning are not as effective in these two modes as in the face-to-face instructional format due to the limited potential of the existing technologies. Poor or time-buffered images, low-speed transmissions and high costs are part of the obstacles that were experienced by educators in embedding interactivity in the distance education program.

Many educators perceive that Digital Television and technology would possibly improve the current state of interactivity in the distance education due to its advanced features. High resolutions and digital transmission would make the communication much more clear and easier. One possible use of Digital television in education, as Carvin (1998) described, would be enhanced TV, which supplemented by multimedia content to provide interactivity for learning needs. Various contents such as web pages, quick time movies and text scripts can be composed into the framework of course design. However, DTV technology is still in an early developing stage. There is insufficient information and few studies had been done for educators for pedagogical uses. It would be necessary to investigate those potential effects DTV could bring to distance education, and what learning aspects DTV would contribute. This review will explore DTV's attributes, discuss some possible applications for interactivity and the underlying theoretical and research bases.

Discussion

The basic job of distance educators is changing adult behavior (Verduin & Clark, 1991). According to the perceptual theory of psychology (Bills, 1959; Combs, 1959), how individuals view people and the objects and events in their environment will greatly influence how they behave. Verduin and Clark (1991) further explained the theory that "Behavior is a function of perceptions. Perceptions can be consciously or unconsciously constructed through several interactions with the environment." "It is through this construction that they tend to display behavior." Environment is critical to distance learners for behavioral changes, so that learning may occur. In distance education, environment relies heavily on the technologies. Through technologies, distance learners are able to interact with environment, communicate with the instructor and other students. In his "guided didactic conversation" (1989) theory, Holmberg proposed seven background assumptions for Interaction and Communication. He believed that the core teaching consists of interaction between the teaching and learning parties. Emotional involvement in the study and feelings of personal relation between the teaching and learning parties is likely to contribute to learning pleasure. Also, a friendly, personal tone and easy access to subject matter contribute to learning pleasure. Learning pleasure supports students motivation, and strong motivation facilitates learning.

The purpose for learning is to be proficient in a field or fields. Knox (1980) in his theories on adult education suggests that proficiency is a key construct and is actually the capability to perform effectively in a given situation. This capability usually depends on some combination of knowledge (the cognitive domain), physical skills (the psychomotor domain), and the attitudes (the affective domain) that the adult processes. Therefore, to enhance an adult's proficiencies and capabilities to perform and to facilitate learning, educator must place the three major domains at the center of instructional thinking and planning for adults (Cranton, 1989). Consequently, to build adult learners' proficiency in the distance environment, it is essential that the three major domains achieved by the students through an interactive manner.

However, the limitation of technology constrains the interaction and give-and-take processes of learning. When interaction is made less complete due to loss of aural and/or visual stimuli, expressions that might have communicated meaning are lost (Verduin & Clark, 1991). Besides, difficult access to subject matter discourages learning pleasure and lessens students' motivation. Many efforts have been put on the improvement of technology-based learning environment to produce interactive instruction and learning activities. Digital broadcasting comes along with advanced features that many educators aware that might bring about a leap in distance education. A discussion of these features from the perspective of Knox's (1980) proficiency domains and interactive learning is followed.

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Video/Audio effects in learning

Audio accompanied by static print materials has demonstrated to be as effective as face-to-face classroom instruction for step-by-step procedural tasks (Wisher and Priest, 1998) as well as graduate education (Burge and Howard, 1990). Similar to audio with static print materials, audio graphics transmits a visual image accompanied by an instructor's voice, usually through audio conferencing to students at remote sites. The students do not see the instructor, but rather attend to content. Audio graphics should result in the same learning outcomes as audio with print materials (Wisher & Curnow, 1999). Both of these two forms support one of the three types interaction occurring in distance education as described by Moore (1989), the interaction between student and content. The type of interaction is most important. In a study that investigates perceptions and effects of image transmission during Internet-based training, Wisher and Curnow (1999) indicated that there are categories of learning for which there is apparently little need to see the instructor, such as learning declarative knowledge or facts. However, there are some learning tasks that instructor's visual clues are required such as training in first-aid procedure or communication skills such as sign language, depending on visual motion cues during instruction (Wisher and Curnow, 1999). In fact, visual images of lesson materials and instructors are both essential depending on different knowledge learning. Instructional or instructors' image can support and facilitate students' cognitive learning domain, according to Bloom's systematic way of viewing cognitive growth (Bloom and others, 1956), from knowledge comprehension, application, analysis, synthesis to evaluation.

DTV is able to transmit lesson content and instructor's image as well as motions. Except for an ordinary image communication, the image will be presented in an aspect ratio of 16:9, which is different from the conventional 4:3. The screen is formatted more rectangular and much closer to the way people see. Image fills more of the field of vision and has a stronger visual impact. Generally, publics consider that a larger and more rectangular screen is preferred by most of the audiences. Besides, DTV has smaller pixels that are close together, so there are more pixels in a space on a screen (4.25:1 compared to NTSC standard). DTV pixels are square, just like most computer monitors, are able to remove image distortion and present a high-resolution image (Cringely, 2001).

But in what degree do student's perceptions and preferences toward video capability relate to learning? Research findings from instructional television indicated that there is generally no significant relationship. In a study by Greenhill, Rich, and Carpenter (1962) that examined preferences for screen size, students are divided into two groups and assigned to small or large screen. The results show that students prefer larger screen, but their preference was not related to achievement in this course. In one other study of the effect of visual display, Johnson and Stewart II (1999) found that more immersive visual display had no effect on gaining special knowledge. However, the size and ratio of screen might have impacts on students' satisfaction to learning experience. Students' satisfaction will have effect on their affective learning domain. Affective domain where receiving, responding and valuing (Krathwohl, Bloom, and Masia, 1964) foster the formation of attitude toward followed learning behaviors.

Audio effect had been found influential to student's affective learning domain. In Kelsey's (2000) study of the interaction in a course delivered by interactive compressed video technology, the most significant and effective barrier to interactions was the limitations and failure of ICV technology. Echoing and squealing noises, as well as time delays and disconnections, inhibited interaction between guest speakers and students. Speech that was mediated through ICV technology lacked the spontaneity and lucid flow that is expected during face-to-face conversion. Students reported that interacting during the live broadcast was problematic because communication delays gave speech a choppy and unnatural sensation.

DTV technology adopts Dolby Digital/AG-3 audio encoding system to broadcast sound. The sound would be much sharper and crispier. DTV broadcasting uses digital high-speed transmission, more consistent the data will stay over distances. Although both analog and digital signals get weaker with distance, while the sound and picture on an analog TV slowly gets worse, the sound and picture on a digital set will stay perfect until the signal becomes too weak. There is convincing reason to speculate that DTV will have positive effects on students' affective learning domain (Cringely, 2001).

DTV and Interactivity

Vrasidas and Marina (1999) in their study of factors influencing interaction in an online course indicated that there are factors directly influence interaction, including learner control, transactional distance, feedback, and social presence. Among the three factors, learner control is central to the notion of interaction. Garrison and Baynton (1987) described that the concept of control consists of three components: independence, power, and support. The proper learner control should be a balance among these three components. To expand more precisely, independence is the degree to which the learner is free to make choices. Power is the abilities and competencies of the learner to engage in a learning experience. Support is the resources available that will enable the learner to successfully participate in the distance education course. Improvement in television delivery methods created new options for distance learners to communicate (Machtimes and Asher, 1996) also might increase the capability of learner control.

Currently, HDTV is the best-known term for digital broadcast TV. When a show is digitally broadcasting on the television, the audience can interact with the content of the show online and get immediate feedback. Yet, the potential for DTV can be greater.

Datacasting

According to the Guidebook to DTV developed by Harris Corporation, DTV will allow broadcasters to deliver ancillary digital data in variety, such as web site materials, multimedia content, program, and non-program related information. DTV is also capable of delivering data hundreds times faster than traditional modem. An enormous amount of content could be sent

through airwaves without requiring the user to subscribe to an online service or to have a wired computer connected to a high-speed Internet connection. These are things that traditional broadcasting can never accomplish.

Digital transmission is operated in a way that more data can be transmit, and more types of data could be carried through the same amount of bandwidth because more information could be carried in a digital signal by using MPEG-2 encoder to compress data. DTV broadcasting technology has one-to-many, real-time, high-speed data-delivery channels. Any program created by educators for delivery over digital media CD-ROM, IP web stream can be transmitted to any individual receiver or all receivers in the coverage area. When TV stations are transmitting less demanding signals, greater capacity for datacasting becomes available (Cringely, 2001).

Multi-casting ability

Instead of broadcasting in a high definition mode, Digital TV can be programmed to broadcast in standard definition mode while it multicasts four choices at the same time and the same channel. Some broadcasters, including many PBS stations, have already planned to multi-cast four choices of programs during the day and then switch to high-definition for prime-time. This option offers more choices, make viewing experiences more interactive (Cringely, 2001).

Interactivity? Or not?

Corporation for Public Broadcasting (CPB) conducted a study (1999), "Will TV viewers want interactivity?" to evaluate prototypes of digital public television programming. According to CPB, the prototypes were designed to demonstrate potential interactive techniques of DTV, and to get reaction from viewers. There are some interesting initial findings. They are summarized as follows:

Benefits of interactivity

- Control: Viewers feel that interactivity allows them to have more control over what and how much they wan to see and learn about a particular topic.
- Additional information: At the most basic level, people want interactivity to provide more detail information.
- Richer viewing experience: Interactive programs are perceived to be more engaging and providing more pleasurable experience.
- Better Education: Almost all viewers in the study see interactive television has a vision of formal and informal educational use of technology.

Negative impact

- Distraction: It is difficult for most people to concentrate on the separate information streams at one time. It is easy to lose focus.
- Weak underlying program: Viewers expressed the fear that producers will spend too much time on the interactivity material and reduce the quality of the program.
- Difficult interface: Viewers get frustrated when the interaction does not occur the way they would like them to, and that different programs have different types of interface.
- Make television too much work: Viewers have a fear that complicated interactivity will make the television too much like computers that they crash, require updating, and viewers need training to operate the television rather than simply click on the remote.

Unanswered questions

After the study, although participants see great potential for interactive digital television, they also left with many questions that need to be answered. According to the report (CPB, 1999), viewers want to know how and when this technology will happen, what will be available, what equipment they will need to get, and how much the hardware and the service is going to cost. They said that they need to get clear answers to these basic questions before they can make intelligent decisions about what hardware to buy, what service to choose, and when they should start the process.

Practical obstacles

As the results of the prototype study show that there are potential problematic and questionable areas in the technology of digital television. Carvin (1998) also summarized several issues that all future broadcaster and consumers of DTV should consider about this technology:

- Cost: At the beginning of any new type of technology, the cost to acquire it can be grant. DTV is no exception. This may put consumers to a halt when buying a piece of equipment that they know little about. Also, consumers may feel reluctant to give up the old analog television that they already have, and they then need to get a converter for the digital signals to decode the transmission to their household. Even the converter can be expensive, at least for some families that need it most to afford. The price for all DTV equipment may go down someday, but not in the most immediate future.
- Content availability: According to Carvin, not so many producers are actively producing materials for the digital market, but a lot of them are taking the analog TV programming and retool it for digital. Therefore, they are not producing the content specifically for the technology. Also, the program content may not even fit with the new

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medium. If the consumers pay to get the old content that they used to see in analog TV, and to find that there is not much available content for the new technology, they may not even want to invest their money on it in the first place.

- Interactivity: Carvin mentioned that though digital TV signal transmission may be advanced, one thing is not changed: DTV is still a one-way stream, similar to the traditional analog TV because DTV spectrum can only be used by licensed broadcasters, not consumers. It means that in order to have interactivity, DTV needs to utilize other ends to have the consumer transmit information back to the broadcasters. So far, Internet seems to be the primary back channel for DTV communication.
- Commercialization: Just like the Internet, when a new technology starts to attract and become accessible to a significant public market, commercialization comes into view. Also, TV networks invest huge amount of money into the transition, and they want to see some pay back from the market. If making a profit is all people think about DTV, they will be unlikely to put educational programming as a priority. Even if Public Television takes up the responsibility to provide educational programming, with possible high cost and moderate return, how long can they last?

Carvin (1998) made no mistake in saying this, " There is a lot of potential in digital television but there are also a lot of excuses for us to not take advantage of it." It makes one think more about how this new technology should be utilize for the better of the society.

Summary

Digital TV is the most recent major advance in television broadcasting in nearly 48 years, with improved audiovisual features, and supposedly it will also improve students' satisfaction level in their learning experience. However, because DTV is relative new and yet to be accessible to majority of the society, little research has been done to see its effects in education. The prototype study conducted by Corporation for Public Broadcasting did yield some exciting findings and implications for DTV program developers as to viewers' feeling of being in control, having richer viewing experience, encountering weaker content, and trouble dealing with complex interface functionality.

David Carvin (1998) also proposed several issues for the public to ponder on about the future of DTV. There is first the cost of hardware or service subscription that may scare people away, then the content availability and quality for DTV programs, DTV interactivity back channels, and the possibility of major commercialization problem for DTV.

In May of 1997, Federal Commission of Communication mandated that the United States begin to replace standard analog television with digital television. By 2002, all commercial network stations need to be finished with their digital process, and by 2003, public broadcasters need to get the job done. Viewers will have the options to continue receiving analog broadcasting, or to purchase a digital television or a converter between 2003 and 2006. By then, stations have to return their analog licenses to the federal government. Between now and then, it is advisable for everyone to think about the future of television.

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